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Zöller 20

THE COKE-OVEN INDUSTRY IN POLAND :

1. General outlook:

In prewar Poland lagged the coke-oven industry far behind that of the heavily industrialised European countries. Coke production was not greater than 2 million metric tons i.e. some 1% of the total world production.

Five of the byproduct coke oven plants were situated at coal mines and four served steel industry in Upper Silesian district. All these plants had an average annual capacity 100-400.000 tons of coke each. The preparation of coal for coking was primitive and comprised storage and crushing only: the Upper Silesian coals used were sufficiently clean, required no cleaning and were used either as mined or sometimes in two - three component blends.

The quality of coke was low. The Micum drum test generally not higher than 40 percent. About 1/3 of the coke was consumed by a metallurgical industry in blast furnaces 200-400 m^3 by volume and the remainder was used for non-metallurgical industrial and domestic purposes.

Some quotas of domestic coke were exported for Scandinavian area. The refined tar and bensole products were processed in one central distilling plant and mainly exported.

A great part of the capital invested in this industry was in foreign hands, and during the pre-war years the principal builders of coking plants in Poland were German, French an Belgian firms such as: Otto, Koppers, Still Distillcoke and Lopulco.

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by the connection of eleven further plants, of which seven in Upper-Silesian and four in Low-Silesian District with an approximate annual capacity of about 4 millione metric tons of coke. From these plants nine were situated at coal mines, one at steel werks and one at a chemical works /Fischer-Tropsch synthesis/ at Zdzieszowice.

In comparison with the pre-war Polands ferritory the mining of cooking coals was doubled, most of the Lower Silesian collieries.

All the 20 plants within the new frontier had been badly damaged in the war and 3 had been virtually destroyed.

In 1945 all industries were nationalised, and by 1947 [illegible] existing coke oven batteries were put into operation. [illegible] most badly damaged batteries were also rebuilt. By 1949 the prewar output of coke within the new area was practically reached. The growth of outputs are shown in table I.

Table I. Hard coke production /1946-1950/ in thousand metric tons.

	coal mined	coke production	coke exports
1946	47.288	3.523	[illegible]
1947	59.129	4.110	[illegible]
1948	70.262	4.648	[illegible]
1949	74.105	5.292	1.865
1950	78.001	5.461	1.7[illegible]

As part of the national programme for industrial develop it was decided to undertake the reconstruction of the coke-oven industry. The existing old coke oven batteries and primitive in general coal preparation plants could not met [illegible]

The coke-oven plants belonging formerly to the State Coal Trust /Centralny Zarząd Przemysłu Węglowego/ and to the State Chemical Trust /Centralny Zarząd Przemysłu Chemicznego/ were amalgamated to form: The State Coke Trust /Centralny Zarząd Przemysłu Koksochemicznego/ together with tar and benzole distilling plants.

This organisation operated till 1954 Under the control of the Ministry od Coal and Energy, and since 1955 it has been under the control of the Ministry for Heavy Industry.

The lo biggest gasworks and all the mains carrying manufactured and natural gas were also combined in one organisation, Known as The State Gas Trust /Centralny Zarząd Gazownictwa/.

To aid the further development of both industries research organisations were formed: these were The State Desing Institute for Coking and Gas Industry /"Koksoprojekt" and "Gazoprojekt"/, The State Construction Organisation /Przedsiębiorstwo Budowy Pieców Przemysłowych"/ and the State Institute for Chemical Coal Utilisation /"Instytut Chemicznej Przeróbki Węgla"/.

In consequence of the growing demand for technologists an intensive training programme in carbonisation processes was established at Polytechnic Schools Gliwice an Wrocław.

Special training schools for operators were also established within the area of the coke-oven and gas industry concentration.

The refractory materials industry had increased in capacity and thus been able to meet some 70% of the requirements of

[illegible] oven machinery and mechanical equipment was [illegible] and later home production became fully organised.

By 1958 eighteen new coke oven batteries were built and put into operation, Table II shows the situation and type of ovens installed.

Table II. Coke oven batteries built 1949-1958.

Battery location	Year of starting up	System of coke ovens	Number of batteries and coke ovens
1. Upper Silesian District:			
Walenty	1949	Otto	1 x 55
Makoszowy	1951	Otto	2 x 28
Gliwice	1951/52	Otto	2 x 35
Kościuszko	1952/54	Koppers	2 x 60
Jadwiga	1953	Otto	2 x 28
Dębieńsko	1954	Otto	2 x 28
2. Low Silesian District:			
Victoria	1954/58	Otto	2 x 35
3. Cracow District:			
Nowa Huta	1954/58	Giprokoks	6 x 57
		total	18; 797

[illegible] during the period 1951-58 is given in Table III.

Table III. Hard coke production /1951-58/ in thousand metric tons.

	Coal mined	Coke production	Coke exports
1951	82.001	5.777	1.432
1952	84.437	6.751	1.636
1953	88.720	7.188	1.819
1954	91.619	7.747	1.854
1955	94.479	9.176	2.264
1956	95.149	9.552	2.308
1957	94.000	9.925	1.950
1958	95.000	10.165	2.045

The gas pipelines and distribution systems for coke oven gas and natural gas were also improved/to give the bette gas utilisation. In Upper Silesia the length of mains was increased from about 95 km in 1945/ to about 600 km in 1958. In central Poland a pipeline some 150 km in length was constructed to convey natural gas to Warsaw.

The Upper Silesian coke oven gas collecting system takes 30% of all the coke oven gas production in that area i.e. above 1000 millions cu.m for the year 1958. The Lower Silesian coke oven gas collecting system takes 44,6% the total coke oven gas production in that area i.e. 282 millions cu.m for the year 1958. The natural gas collecting system in the south distributes 600 millions cu.m of which about 200 million cu.m are imported from the U.S.S.R.

Further developments in gas production and coke oven gas distribution are planned. A number of modern coke oven batteries are under construction. A new coking plant in

being installed at Steelworks in Częstochowa [illegible] with a coke oven gas grid system Cracow-Upper Silesia-Częstochowa and Warsaw. The are 188 gasworks in Poland with a total capacity of 600 million cu.m of town gas a year. Gas coke production amounts to about 950.000 tons /1958/.

Lurgi low-temperature carbonisation plants are used to produce about 250.000 tons of semicoke. At the present time it exists some trend to widen the scale of that process in connection with the production of "formed" blast furnace coke on the basis of semicoke.

Tables IV and V show analyses of coke and gas output for 1958

Table IV. Analysis of coke consumption /1958/ in percent of total hard coke production inclusive gas coke and semicoke /11,4 million ton = 100%/

blast furnaces	- 34,5%
other industrial purposes	- 30,3%
heating and domestic purposes	- 17,2%
exports	- 18,0%
total	100,0%

Table V. Analysis of gas consumption /1958/ in percent total coke oven gas, natural and town gas 5850 million cu.m /4000 kcal/Nm^3/

consumption for gas production purposes	- 32,5%
distributed /3950 mill.cu.m	- 67,5%
i.e.	100,0%
steel	41,2
machinery	7,2
chemicals	8,2
power stations	9,5
petroleum	2,0
coal industry	0,6
other industries	4,1

Industrial consumption	74,2
domestic consumption and communal sectors	22,3
exports	0,5
Unaccounted for	3,4
total	100,0%

2. Polish coking coals

The classification of Polish coals by rank, as developed by Koga and Laskowski is shown in Table VI.

Table VI. Polish classification system of coals by rank.

Type	Index	Volatile matter content	Roga Test	Swelling pressure P^a kg/cm^2	Shrinkage x^a	Thickness of plastic layer Y^a	Calorific value Q_c^b
Flamecoal	31	31,1 31,2 31,3	30	0-10			6800-7300 7300-7800 7800
Gas-flame coal	32	32,1 32,2	30	10-35			7800-8100 8100
Gascoal	33		30	35-50	0,10	20	13
Gas-coking coal	34		28	50-65	0,1-0,3	15-30	12-15
Ortho-coking coal	35		22-30	50-65	0,3-3,0	26	25-23
Meta coking coal	36		17-22	25-55	0,3-3,0	16	2-18
Semi-coking coal	37		14-18	10-30	0,3	16	2
Lean coal	38		10-16	0-10	0		

Polish coal deposits measured to a maximum depth of 1200 m amount to some 72,000 million metric tons i.e. some 1/3 of all European coal deposits excluding the USSR.

The analysis by rank of coal deposits is shown in Table VII

Table VII. Analysis of coal deposits in percent by polish classification system:

	in reserve	being worked
type 31-32 long flame coals	79,2	83,0
type 33 gas coals	12,5	10,0
type 34 gas-coking coals	4,7	5,0
type 35-38 coking coals	2,9	2,0
total	100,0	100,0

Out of some 17 million tons of gas and coking coals mined in 1958 the consumption was as follows:

coke oven plants	- 13,2 mill.tons
gas works	- 1,4 " "
other purposes and exports	- 2,4 " "

An average analysis of coals blended for use in coke oven plants in 1950, 1955 and 1958 is shown in Table VIII.

Table VIII. Coal blends for use in coke oven plants 1950,1955,1958 in percent, by polish and international classification system.

		1950	1955	1957
Type and index by Polish classification system:				
gas coals	33	31,8	41,7	44,7
gas-coke coals	34	47,6	37,8	36,6
ortho coking coals	35	[illegible]	5,3	5,0
meta-semi-coking and lean coals	36-38	13,6	9,2	8,8
total		100,0	100,0	95,1
imported coals /ortho coking/		-	-	4,9

Type and index by International Classification System - approximate:

IV - 312		13,6	9,2	8,8
V B - 434		7,0	5,3	9,9
V D - 633		47,6	37,8	36,6
VI A- 622/623		22,5	25,6	25,5
VI B- 621		9,3	22,1	19,2
	total	100,0	100,0	100,0

Some technical data concerning blending coals used in polish coking plants is shown in table IX.

Table IX. Technical data concerning polish blending coals.

Type and index by International Classification System:	Volatile matter content % /moister ashfree/	Roga test	Swelling Index	Swelling Pressure kg/cm2
IV - 312	14-20	10-30	1-2	0,1
V B - 434	22-25	30-85	6-8	0,3-1,0
V D - 633	29-32	30-85	4 ½ - 6	0,1-0,3
VIA - 622/623	32-35	30-55	2-4	0,1
VIB - 621	33-38	20-35	1-2½	-

Coals used for coking are at present won from 31 collieries The types of coal obtained being as follows:

19 collieries	- gas coal /type 33/
8 collieries	- gas-coke coal /type 34/
1 colliery	- orthocoking coal /type 35/
3 collieries	- meta-semicoking and lean coals /type 36-38/

Nearly all the gas coals, about 80% of the gas coke coals and Some 35% coking coals /orthocoking/ are mined in Upper Silesian coal bassin - the rest comes from collieries in Lower Silesia.

The [illegible]

shown in Table X.

Table X. Analysis of coal cleaning for coking purposes /1958/ in percent:

Coal type and index by Polish classification system:	Washed coal	Pneumatically cleaned	Unwashed coal	Total
Gas-coals type 33	44,3	-	55,7	100,0
Gas-coke coals type 34	78,0	1,8	20,2	100,0
Coking coals type 35-38	97,4	-	2,6	100,0
total coal blend in average:	65,4	0,7	33,1	100,0

Coal washing takes place at the collieries. The general trend is to supply coke oven plants with one homogeneous mixture of washed coal sized 0-80 mm. The general trend is also to widen a scale od washed coals in blends practically to 100% and to diminish ash content in coal blend to 7%, at the moment it is 7,5-7,8% in average.

The sulphur content of Polish coals is low and constant, therefore sulphur content in the coke amounts 0,95-1,0%. Some new collieries to mine deposits of typical coking coals are planned and in construction. One new colliery in Upper Silesian will give first quotas of coking coal.

3. Technical progress in carbonisation practice.

Certain progressive trend in the development of the Polish coke oven industry since the war are shown in Table XI.

Technical progress in carbonization
practice /1950 - 1958/.

	1950	1955	1958
1. Average output of coke per oven tons/year	2705	3533	3790
2. Coke production made in post war time modern silica coke ovens /% of total production/	9,3	31,3	42,5
3. Capacity of coke plants attached to the steel industry in % /to total capacity/	19,6	26,5	37,4
4. Production of metallurgical coke above 40 mm x in thous.metric tons	3025	6444	6650
5. Quality of metallurgical coke /in % of total metallurgical coke output/			
Class I Micum Test 70	9,5	26,6	29,4
Class II " " 60	50,4	34,9	42,3
Class III " " 50	40,1	38,5	28,4
6. Consumption index metallurgical coke kg/t pigiron	1280	1179	1021
7. Yield of by products /% by weight of dry coal/			
coal tar-dry	3,24	3,40	3,40
light oil	1,14	1,07	1,16
ammonia	0,232	0,234	0,229

Special attention was paid to improving the quality of the coke supplied for operating new large scale blast furnaces erected at Steal mills in Nowa Huta Near Cracow /1386 and 1033 cu.m volume, Czestochowa /868 cu.m./ and Chorzów /86 cu.m/.

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x/ Notice: Excluding domestic coke above 40 mm, Micum Test of which is about 80%.

[illegible] coking plants were supplied with [illegible] and the following formulations and the following typical size [illegible] of coal blends was obtained:

- 0,5 mm	about	49,0%
- 1,0 mm	"	71,0%
- 2,0 mm	"	88,5%
- 3,0 mm	"	96,0%
- 5,0 mm	"	99,2%

The blends and coals /volatile matter content varying between 30 and 33% on dry, ashfree basis/ are generally stamped. Over 94% of the total coking capacity is constructed for stamping to obtain a density between 950 and 1000 kg/per.cu.m /dry coal/. Moisture content of coal charged is 8-9%. Some 52% coke ovens are of the underjet compound type: typical width 440 to 480 mm /with taper 40 mm or without taper/, typical height 3600 mm, volume of coke chamber 20 cu.m. Temperatures in the heating flues average about 1300° - 1330°C.

For production of the best metallurgical coke /M40 $\geq$ 70% for biggest blast furnaces and M40 $\geq$ 75% for foundries/ only washed coals are taken from selected collieries.

Metallurgical coke for blast furnaces, is generally used in one size above 40 mm, for foundries it is used in two sizes: > 80 mm. and 63 - 80 mm.

Non metallurgical coke only is screened in typical sizes of over 80 mm, 80-63 mm and 63-40 mm. The remaining smalls are graded into 40 - 20; 20 - 10; 0 - 10 mm.

The actual structure of the coal blends available is not entirely for the production metallurgical coke with the best mechanical properties, as can be seen from the [illegible] results.

[illegible] project [illegible]

[illegible] ash [illegible]

[illegible] of homogeneity is obtained in some of the [illegible] plants and it is in our opinion the important factor for t[illegible] economical coke consumption in our biggest blast furna[illegible] of wet coke per ton pig iron as obtained in 1958 at Nowa Huta and Częstochowa using ore with 39% - 41% of iron in average.

The introduction of selective coal preparation and also high pressure stamping equipment to obtain a higher coal blend density is being considered.

The by-product plants are typical for ammonia recovery by a the semi direct method and light oil absortion with wash oil at atmospheric pressure. Gas cleaning, tar distillation and light oil distillation is organised centrally - in both last cases to some 2/3 in continuous distilling units. The range of by products chemicals includes typical products such as pure benzene, toluene, xylene, coumarone resins, crystalline phend, cresols, xylenol-mixture, pyridine bases, naphtalene, anthracene and tar oils. The new refining process of light oil by catalytic hydrogenation has not yet been introduced. Some 25.000 tons of pitch coke are produced in last years. Recovery of phenols from waste liquors is carried out at 6 coke oven plants - 4 by extraction with crude light oil and 2 by the Koppers evaporating method.

4. Conclusion.

Polish postwar technical literature on coal carbonisation reveals great activity both in research and practice. [illegible] coking industry working with relatively poor [illegible]

good coking coal [redacted] see its ouput of hard coke each year and furthermore, [redacted] a steady improvement in the quality of the coke.

The fact that we make the best use of all coking coals, including some of very poor coking properties contributes in our opinion towards the overall equilibrium of the European coal economy.